



Case report

Multidisciplinary approach to fatal dog attacks: A forensic case study



Nidhal Haj Salem, MD*, Meriem Belhadj, MD, Abir Aissaoui, MD,
Mohamed Amine Mesrati, MD, Ali Chadly, PhD

Department of Forensic Medicine, Universital Hospital Fattouma Bourguiba, Faculty of Medicine, University of Monastir, Al Munastir, Tunisia

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ABSTRACT

Dog-bite-related injuries and fatalities are increasing in incidence and represent an important public health concern, as dogs are more and more becoming an integral part of human social life.

We report the case of a 27-year-old woman who was found dead in her home. Her body was discovered lying face down in a large pool of partially desiccated blood with signs of having been dragged. Site examination revealed the presence of severe injuries on the face, neck and head, which were then traced back to the dog she owned. Death was attributed to exsanguinations due to a neck blood vessel's laceration with fracture of the fifth cervical vertebra. This was uncommon because the dog bites injured the vertebral artery only without any lacerations of the carotid artery.

Confirming that the injuries are dog-bite related was based on a multidisciplinary approach including histological findings, odontological examination of bite marks and DNA analysis.

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1. Introduction

Dogs are social animals known to have an inherent pack instinct. They can become excited and aggressive and therefore attacks may occur. Many cases of dog attacks have been reported and sometimes the severity of the wounds can lead to death.¹ In the literature, dog-bite frequencies have been estimated at between 9 and 18 per 1000 subjects.²

Many epidemiological studies indicate that the majority of dog-pack attacks are among children or elderly women³ and this can be considered as a worldwide problem.⁴

Most cases of death involving the presence of domestic-animal bite marks are actually non-violent in nature; these marks are often mistaken for signs of criminal assault,⁵ which highlights the importance of an accurate post-mortem examination to clarify whether such an injury occurred before or after the time of death and its imputability to the presence of animals at the death scene.

Forensic approaches to fatal dog attacks have been published.^{5,6} The investigations usually involve the examination of bite marks and tooth prints. Then the detection of the offending dog can be made by comparisons of the dental casts of the dog with the victim's wounds. It is also possible to obtain a canine-specific short tandem repeat (STR) profile from the dog's saliva left on the wound area,^{7,8} which may provide a link between the victim and the suspected animal.

In the following reported case, we tend, by a multidisciplinary approach, to assess the cause of death and the aetiology of the injuries observed on the corpse.

2. Case report

2.1. Investigation of the death scene

A 27-year-old woman was found dead in her home. The body was discovered near the front door of the home, lying in a large pool of partially dried blood with signs that the body had been dragged. Her clothes were intact except for a scarf around the neck presenting multiple tears compatible with the following-cited injuries found on the neck. Initial findings indicated that the victim had died <6 h before the discovery of her body.

The victim had a history of epilepsy and the dog (Fig. 1) was known to have lived with her, and the victim used to ask for help whenever she had a seizure.

2.2. Autopsy finding

The autopsy was carried out about 16 h post mortem.

On external examination, she appeared well nourished with post-mortem lividity of low intensity and consistent with the supine position. There were severe injuries of the neck and head. The wound's edges revealed many small parallel, partially curved superficial notch marks suggestive of bite wounds.

* Corresponding author. Tel.: +216 22407630.

E-mail address: nidhal.hajsalem@yahoo.fr (N. Haj Salem).



Fig. 1. The Dog seen in the death scene.

The left ear, in particular, was totally missing, which made the ear cavity and bones visible.

The examination revealed an extensive soft-tissue loss of the scalp exposing the bone. Analysis of the skull revealed numerous indentations and striations, which were particularly evident on the peripheral area of the missing scalp (Fig. 2). Samples of subcutaneous tissue were collected for histological analyses aiming to confirm the vitality of the lesions. These samples revealed haemorrhagic reactions in the cutaneous, subcutaneous and muscle tissue.

There were multiple stab wounds and lacerations over both sides of the neck, in particular on the right side there were lacerations 3.7–2.7 cm in length. The distance separating the two right lacerations was 3.5 cm. The wound margins, showing signs of vital subcutaneous bleeding and some irregularity, were globally regular in shape (Fig. 3).

A series of individual abrasions and contusions, C-shaped and reflecting the size, shape, arrangement and distribution of the class



Fig. 3. Multiple stab wounds and lacerations of the neck (the right side) with distance separating the two right lacerations.

characteristics of the contacting surfaces of animal dentition, were found on the right cheek (Fig. 4).

The rest of the corpse appeared unscathed except for multiple bluish bruises in the left hand.

Internal examination showed that the right sterno-cleido-mastoid muscle was crushed; the right internal jugular vein and vertebral artery were lacerated about 2 cm at the level of the fifth cervical vertebra (C 5). The C 5 vertebra of the corpse was fractured about 0.3 cm in length. There was a disjunction between the second and the third cervical vertebrae (C2–C3). The thyroid cartilage and the laryngeal cartilage were also fractured. The hyoid bone was intact. These findings were confirmed by an X-ray examination. There was extreme bleeding around its soft tissues.

The body cavities were intact, with no pathological findings.

Histological and toxicological examinations did not reveal any extra relevant findings. Death was attributed to exsanguinations due to the neck blood vessel's laceration subsequent to a dog bite.

2.3. Investigations of the dog and bite mark analysis

The offending dog was captured. After anaesthetisation, dental examination was carried out. Inter-canine and inter-incisal distances were recorded using a digital calliper.



Fig. 2. Cutaneous samples from the forehead and the scalp where the majority of bite lesions were located.



Fig. 4. Bite analysis with distance separating lesions.

A comparison was made between the cutaneous samples where the injuries were located and the dental distance measured in order to verify the compatibility of the marks and confirm the dog's responsibility for the injuries sustained. The first injuries to be investigated were those which had not lacerated the skin, particularly the bite wounds. The pointed lesions were caused by canine and the straight by incisive teeth. These marks were made by the slipping of the teeth against the skin or by the imprinting of the lingual surfaces of the teeth. The inter-canine and inter-incisal distances measured were compatible with the distance between the mesial points of the injuries.

Following this, the destructive injuries on the neck, such as the stab wounds, were examined. The action of the canines was more evident here. We found a concordance between the inter-canine distance measured in the dog (3.5 cm) and the mesial points of the injuries (3.5 cm).

A DNA analysis was performed in order to confirm the dog attack. The results show the presence of the victim's blood on the dog canines.

3. Discussion

Dog-bite-related injuries and fatalities are a major health problem worldwide. The dog-bite death rates in Australia and the US range between 0.004 and 0.07 per 100,000 inhabitants.² The highest mortality rate is registered for children and elderly people because they are generally weak and defenceless.⁹

Generally, and as found in the reported case, most frequent sites of injury are the head, face and neck.⁶

Lesions usually involve a combination of biting, clawing and crushing forces resulting in wounds with a characteristic pattern of punctures, lacerations and avulsion of the skin and other soft tissues.¹⁰ The bite force of an adult dog can range from 1380 to 3105 kPa¹¹

During such attacks, dogs move their heads vigorously as they bite, which compromises the tissue integrity. Death will result from asphyxiation, exsanguinations or a fractured skull and its associated complications.

The bite marks of carnivorous animals vary, but they leave predictable patterns on the bone tissue as a result of various factors such as the jaw size, bone density and bite force. Bone tissue damage caused by carnivores is ragged and leaves behind a series of tooth-sized pits and indentations along the margin.¹²

Odontological analysis of bite marks may provide conclusive evidence in identifying the offending animal. Unlike man, dogs have asymmetric upper and lower dental arches.¹³ The shapes of dog-bite wounds will vary considerably, depending on the size and breed of the dog. There may be wide gaps between the impressions made by the different teeth.¹⁴

In the case reported here, the particular shape and pattern of the lacerations and the stab wounds found on the right side of the neck, indentations on the peripheral area of the missing scalp and the concordance of bite wounds to the animal characteristics, especially the distance between the canine and the mesial points of injuries, were consistent with the action of canine teeth.

Penetrating neck injuries are common and are included in 25% of vascular wounds.¹⁵ Injuries to the internal jugular vein are among the most common. They occur in 11% of approximately 1500 penetrating neck injuries.¹⁶ Vertebral arterial injuries are, however, uncommon and account for about only 1% of all neck-vascular injuries.¹⁷

The present case is a jugular venous with vertebral artery lacerations causing a severe haemorrhage leading to death. We conclude that the vertebral artery injuries were caused directly by a dog bite, and not indirectly produced by a fractured transverse process at the

level of the C5. Because the vertebral artery laceration was about 2 cm in length, it is much longer than the fractured transverse process lesion. Dog-bite-related carotid artery or extremity artery injuries have sometimes been reported.¹⁸ The present case is rare, because the dog bites injured the vertebral artery only, without any lacerations of the carotid artery.

Oshima et al.¹⁰ reported the case of a dog-bite-related fatality in an old woman who died from a vertebral arterial laceration with a C 5 vertebral fracture.

The reported case is also a C 5 vertebral fracture with C2–C3 disjunction. It has been reported that 44% of cervical spine fractures are caused by penetrating trauma.^{19,20} This can be explained by the high bite force delivered by the dogs, which can reach 3105 kPa.

Laryngeal fracture, secondary to a dog bite, had also been described.¹⁸ In the present case, thyroid cartilage and laryngeal fractures may cause asphyxia leading to death. This diagnosis is unlikely based on the autopsy findings, in particular the absence of congestive signs.

The absence of self-defence injuries suggests that the dog's attack occurred probably during the post-critical phase of an epileptic seizure when the victim was unconscious. Difficulties consist in determining whether the injuries occurred before or after death.

Verzeletti et al.²¹ reported the case of a woman with extensive facial wounds who died of natural causes. The post-mortem aetiology of the injuries was determined on the basis of the absence of signs of vital reactions such as haemorrhagic infiltration or marginal inflammation. Making a link between the injuries and the dog present at the scene of death was based on testing methods such as a serological species diagnosis (the dog antigens were detected in and around the lesions covering the face of the deceased).

In the reported case, samples of subcutaneous tissue collected for histological analyses revealed haemorrhagic reactions in the cutaneous, subcutaneous and muscle tissue confirming the vitality of the lesions.

A forensic approach for the identification of the offending dog has been reported. It usually includes the examination of bite marks and tooth prints and DNA analysis.^{6,7} Actually, it is possible to obtain a canine-specific STR profile from the dog's saliva left on the wound area.^{7,8} In the literature, the canine STR analysis has proved to have a high specificity, similar to human STRs, and a database of pure and mixed breeds is described.²²

Other testing methods, such as a serological species diagnosis, can be used despite its being less sensitive than DNA analysis.^{21,23}

In the case reported here, a serological species diagnosis has not been performed because of technical difficulties and we opted for the bite mark and DNA analysis. The inter-canine and inter-incisal distances measured were compatible with the distance between the mesial points of the injuries on the neck and the scalp.

Confirmation of the fact that the injuries found are related to a dog bite was made on the basis of histological findings (pre-mortem injuries), odontological examination of bite marks and DNA analysis.

4. Conclusion

The presence of animals at the death scene may pose questions to forensic investigators. In fact, the injuries found on the corpse of the deceased can be mistaken for signs of criminal assault. Confirming that the injuries found are related to an animal bite suggests a multidisciplinary approach including a detailed assessment of the scene, the victim and the animals involved. The most useful methods are the odontological examination of bite marks and DNA analysis.

Ethical approval

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Conflict of interest

None.

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